SUBSURFACE INVESTIGATION AND MONITOR WELL INSTALLATION REPORT WARREN COUNTY LANDFILL WARRENTON, NORTH CAROLINA

93-01

Prepared For:

Warren County Health Department
540 West Ridgeway
Warrenton, North Carolina

Prepared by:

Westinghouse Environmental and Geotechnical Services, Inc.
3500-B Regency Parkway
P.O. Box 1308
Cary, North Carolina 27512

January 1990

Westinghouse Environmental and Geotechnical Services, Inc.

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January 24, 1990

Mr. Dennis W. Retzlaff, Director
Warren County Health Department
540 West Ridgeway
Warrenton, North Carolina 27589

Reference: Subsurface Investigative and Monitor Well Installation Report Warren County Landfill
Warrenton, North Carolina
Westinghouse Project No. 4112-89-123

Dear Mr. Retzlaff:

Westinghouse is please to submit this report describing the subsurface investigation and monitor well installations at the referenced facility. This report also includes the results of the initial ~~quarterly~~ sampling event at the facility.

Westinghouse appreciates this opportunity to be of service to you. As always if you have any questions or comments do not hesitate to contact us.

Sincerely,

WESTINGHOUSE ENVIRONMENTAL AND GEOTECHNICAL SERVICES, INC.

Brian L. Hayes

Brian L. Hayes, P.G.
Staff Geologist

David L. Goodrich

David L. Goodrich
Senior Hydrogeologist

BH/DG/es

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SECTION 1

INTRODUCTION

Westinghouse Environmental and Geotechnical Services, Inc. (Westinghouse), at the request of the Warren County Health Department, developed a ground water monitoring plan for the Warren County Landfill. This plan included well design, sampling frequency, and recommended laboratory analyses. The plan was submitted to the Solid Waste Management Division (SWMD) and approved by SWMD in correspondence dated August 14, 1989.

This report describes field activities by Westinghouse personnel including drilling, well installation, well development, and sampling. The geologic and ground water conditions on the site are discussed. The analytical results are discussed and conclusions developed from all the data.

SECTION 2

METHODS

This section describes field activities associated with implementing the monitoring plan, drilling, well installation, well development, sampling, and surveying.

2.1 TEST BORING AND WELL INSTALLATION

A total of four test borings were performed at the site, as shown in Figure 1. The borings were done using a Central Mine Equipment (CME) - 750 all-terrain-vehicle mounted drill rig. The boreholes were advanced using 4.25-inch ID continuous-flight hollow-stem augers. Soil samples were collected at selected intervals using a split barrel sampling device in accordance with ASTM D-1586. A geologist was present during drilling operations to observe drilling, collect samples, and log the boreholes. The boring logs are presented in Appendix A.

After the completion of each borehole, a ground water monitor well was installed. A ten-foot section of slotted PVC screen and PVC riser was installed in the borehole. A filter pack consisting of fine sand was emplaced in the annulus to a depth of approximately one foot above the top of the screen. A bentonite seal, approximately two feet thick, was emplaced in the annulus above the sand, the remainder of the annulus was filled to the surface with a neat Portland cement grout. A steel protective cover with a locking cap and lock was installed. The details of

well construction are presented in the schematic figures in Appendix B.

2.2 WATER LEVEL MEASUREMENTS

On December 6, 1989, Westinghouse personnel were onsite to develop and sample the wells. Prior to purging, water level measurements were taken each of the wells. The depth to water measurements and ground water elevations are presented in Table 1, as well as the calculated volume of water standing in the well.

2.3 WELL DEVELOPMENT

Prior to sampling, the wells were developed to improve hydraulic communication with the formation. The wells were developed by surging and bailing each well with a dedicated, closed-top teflon bailer and clean nylon rope. Bailing continued until the water was clear or only slightly turbid. This occurred when between eight to ten well volumes had been removed. The total volumes of water removed from each well are presented in Table 1.

2.4 SAMPLE COLLECTION

After purging, the wells were sampled. The samples were collected using a dedicated closed-top teflon bailer. The samples were placed into the appropriate sample containers, labelled, logged on a chain-of-custody form, placed into a cooler, and chilled to approximately 4°C with wet ice. The samples were then transported to Cary, North Carolina and submitted for analysis to

Industrial and Environmental Analysts, Inc. of Cary, North Carolina.

2.5 SURVEYING

A survey of the site was conducted by Bobbitt Surveying to acurately determine the location and elevation of each of the monitor wells. The resultng data was used in contructing ground water flow maps and cross-sections.

SECTION 3

GEOLOGY

3.1 REGIONAL GEOLOGY

Warren County is located in the eastern portion of the Piedmont Physiographic Province. The topography of this region is slightly to moderately undulating and is subdivided by a system of valleys and ridges that exhibit no discernable trend. The ridges are the remnants of an ancient peneplane which has been thoroughly dissected. The lack of trend is directly related to underlying bedrock structure.

The geology of Piedmont North Carolina consists of fractured and folded igneous and metamorphic rocks covered almost everywhere by some combination of saprolite, alluvial deposits, and topsoil. Saprolite is that material derived from in-situ weathering of bedrock, whereas alluvium describes those naturally occurring materials that have been transported by water and deposited in the floodplain region of rivers, streams, or other drainage features. Topsoil includes near-surface soils containing a significant amount of organic material. Collectively, this overburden is termed regolith and its thickness in the Piedmont is quite variable, ranging from 0 to over 100 feet. The average thickness of regolith in the Warrenton area, that is the average depth to bedrock, is approximately 50 feet.

Bedrock in the vicinity of the site is part of the Raleigh Belt which is predominately granitic intrusive rocks and felsic metamorphic rocks.

3.2 SITE GEOLOGY

The landfill is located southeast of Warrenton and trends west northwest to southeast along the crest and north facing slope of a ridge trending northwest and southeast. The surface drainage is towards the north towards an unnamed tributary of Possum Quarter Creek.

Subsurface conditions at the site are characterized by residual soils or saprolite. The saprolite generally consists of silty micaceous sands and micaceous silts.

No boulders or outcrops were exposed on the site, however, cobble-sized float was present at the surface. Bedrock was encountered at depths ranging from 15 to 28 feet below the surface at the borings for MW-2 and MW-3, as shown in Figure 2. Based upon samples recovered, the bedrock consists of mica schist.

3.3 GROUND WATER

The saprolite forms the uppermost hydrostratigraphic unit at the site. Ground water occurs within the pore spaces of the saprolite under water table conditions over the entire site.

The top of the saprolite hydrostratigraphic unit occurs at the water table and is free to rise and fall in response to ground water recharge and discharge. The base of the unit coincides with the top of bedrock. Water levels measured in the monitor wells indicate that the water table is relatively shallow, occurring between 3 and 30 feet below land surface. The tabulated water levels were also used to determine the general direction of ground

water flow across the site, as shown in Figure 3. The figure illustrates water level elevation in the uppermost hydrostratigraphic unit and indicates that flow is towards the east.

SECTION 4

ANALYTICAL RESULTS

The ground water samples were analyzed for the following parameters; arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, copper, iron, manganese, zinc, chloride, fluoride, nitrate, sulfate, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total organic halide (TOX), and total dissolved solids (TDS). The analytical report is presented in Appendix D. The results are summarized in Table 2.

Six of the metals, arsenic, cadmium, chromium, mercury, selenium, silver and fluoride, were not reported in concentrations at or above the method detection limit (MDL). Copper was reported in two wells, but at concentrations below the maximum concentration level (MCL) for Class GA Ground Water. Iron was reported in all four wells at concentrations that exceeded the MCL. Manganese was reported in all the wells at concentrations exceeding the MCL. Barium was reported in all four wells but below the MCL. Lead was reported in three wells but was below the MCL. Zinc was reported in all four wells but below the MCL. Nitrate was reported in only one well (MW-1, the upgradient well) but below the MCL. Sulfate was reported in only one well but below the MCL. The reported concentrations of TDS were below the MCL. No standards have been set for BOD, TOC, and TOX in ground water as of this date.

The analytical data indicates that these ground water conditions are typical for the eastern Piedmont region.

SECTION 5

CONCLUSIONS

Based upon field observations and analytical data, the following conclusions have been developed.

- The predominant overburden material on the site is saprolite.
- The saprolite is derived from the in-situ weathering of the mica schist bedrock.
- Ground water analyses indicate that iron and manganese concentrations exceed the Class GA ground water quality standard but are not unusual for naturally occurring water in the region.
- Based on the information presented herein, the presence of the landfill does not appear to have adversely impacted the ground water quality in this area.

TABLE 1

Summarized Field Measurement Data
Warren County Landfill
Westinghouse Project No. 4112-89-123

Well	M.P.[a] Elevation (ft)	Depth to Water[b] (ft)	Water Level Elevation (ft)	Total Depth[b]	Standing Water in Well (ft)	Volume of Water (gal)	Volume Purged (gal)	Temp. (°C)	pH	EC[#]
MW-1	378.02	31.81	346.21	41.37	9.56	1.6	20	18.5	5.2	111μs
MW-2	318.34	5.88	312.42	15.70	9.82	1.6	20	18.5	5.7	105μs
MW-3	299.48	5.22	294.26	28.43	23.21	3.8	25	18.5	6.2	110μs
MW-4	282.53	4.33	278.18	22.40	18.07	2.9	25	18.0	6.5	104μs

[a]Measuring Point Elevation

[b]From M.P.

[#]Specific Conductance

TABLE 2

Summarized Analytical Results
Warren County Landfill
Westinghouse Project No. 4112-89-123

Sampled 12-6-'89

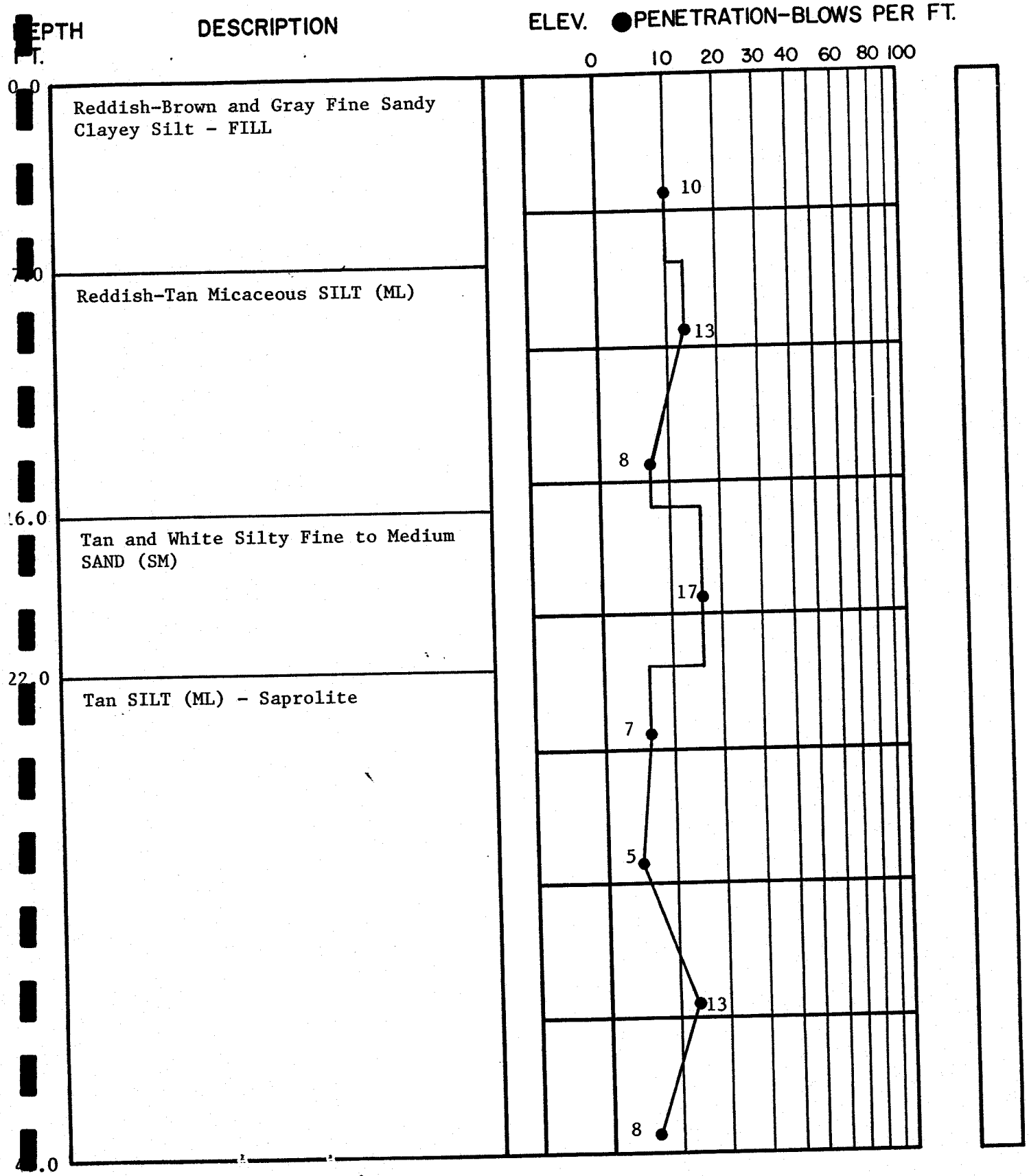
Analyte	MCL[a]	MW-1	MW-2	MW-3	MW-4
Copper	1.0	<0.03	<0.03	0.06	0.04
Iron	0.3	0.49	7.4	3.0	2.6
Manganese	0.05	0.65	1.1	0.47	0.35
Barium	1.0	0.23	0.46	0.22	0.08
Lead	0.05	0.006	0.007	<0.005	0.008
Zinc	5.0	0.07	0.06	0.06	0.04
Chloride	250	11	8.4	3.3	3.5
Nitrate	10.0[b]	0.41	<0.10	<0.10	<0.10
Sulfate	250	2.2	<2.0	<2.0	<2.0
Biochemical Oxygen Demand	N/A	6.8	<2.0	<2.0	<2.0
Total Organic Carbon	N/A	35	26	19	23
Total Organic Halide	N/A	3.0	2.6	1.9	2.8
Total Dissolved Solids	500	40	30	100	20
Chemical Oxygen Demand	N/A	<25	<25	<25	<25

All concentrations are in mg/L.

[a]Maximum Concentration Level

[b]Expressed as Nitrogen

Arsenic
Cadmium
Chromium
mercury
Selenium
silver
flouride
← Detection Limits



Boring Terminated @ 40.0'

TEST BORING RECORD

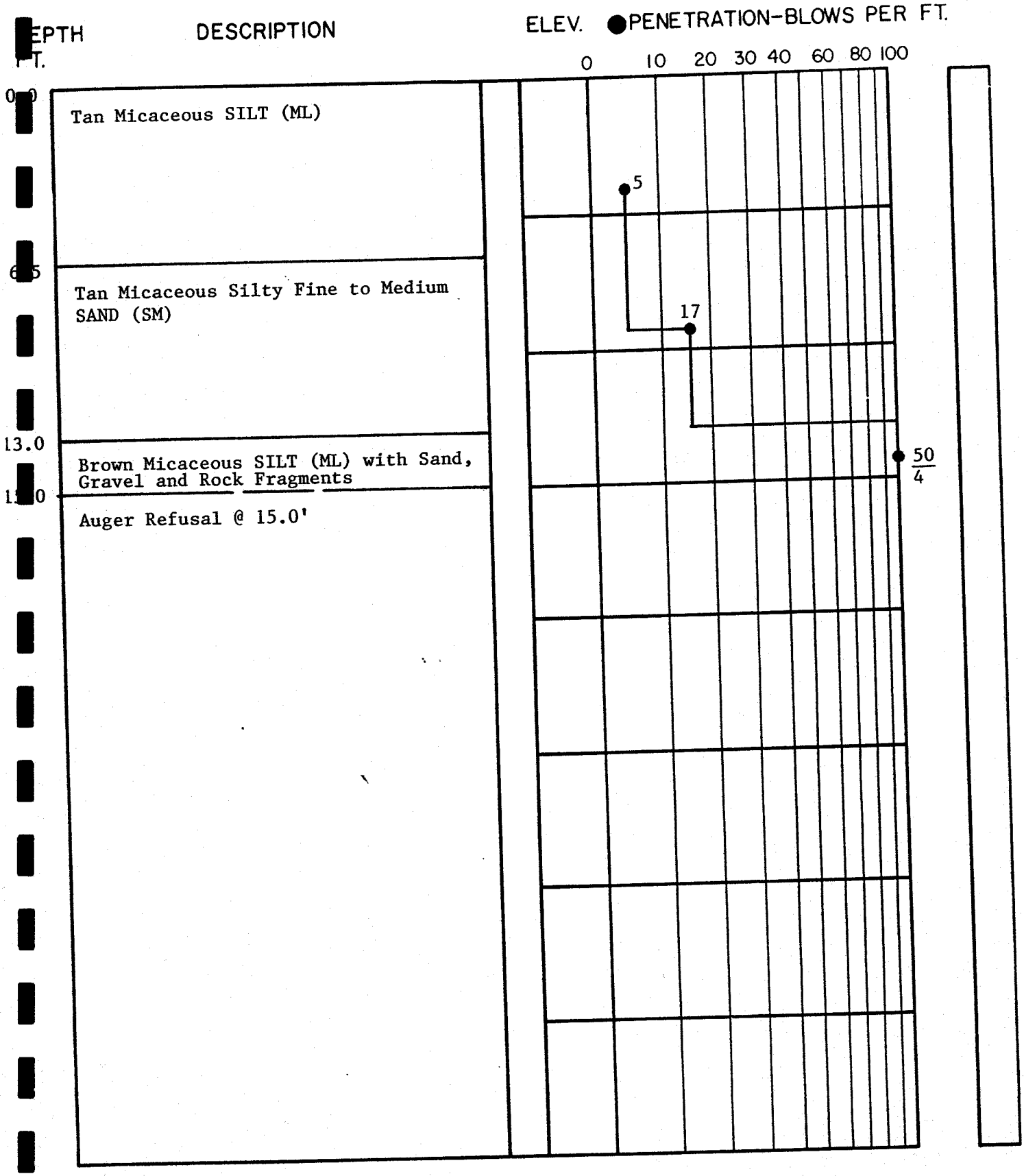
BORING NO. MW-1
DATE DRILLED 10-11-89
JOB NO. 4112-89-123

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER. FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24HR.
WATER TABLE-1HR.

Westinghouse



TEST BORING RECORD

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

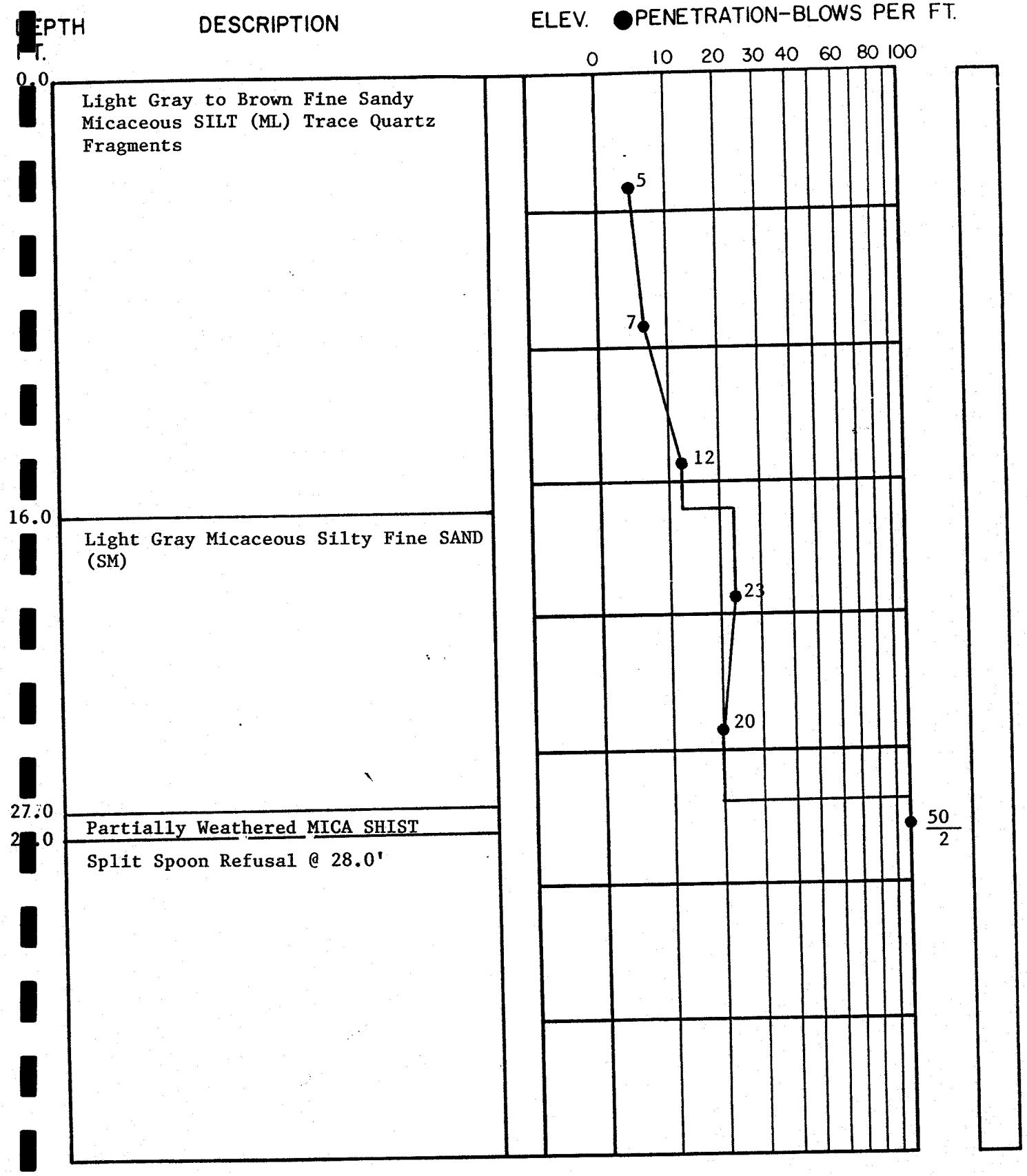
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER, FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24 HR.
WATER TABLE-1 HR.

BORING NO. MW-2
DATE DRILLED 10-11-89
JOB NO. 4112-89-123

Westinghouse

SM-14



TEST BORING RECORD

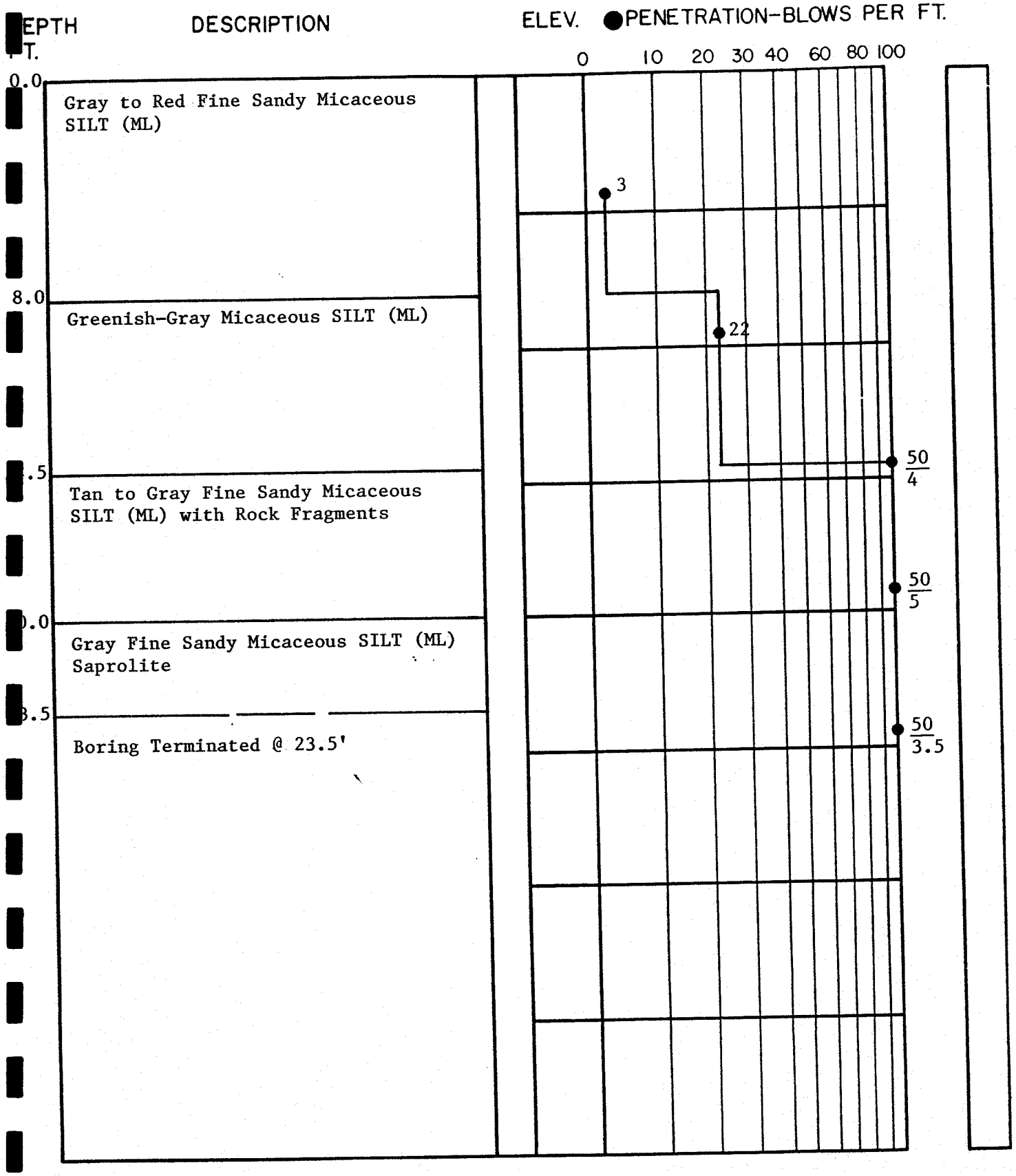
BORING NO. MW-3
DATE DRILLED 10-10-89
JOB NO. 4112-89-123

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER. FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50% ROCK CORE RECOVERY
LOSS OF DRILLING WATER
WATER TABLE-24HR.
WATER TABLE-1HR.

Westinghouse



TEST BORING RECORD

BORING NO. MW-4
DATE DRILLED 10-10-89
JOB NO. 4112-89-123

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER, FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
◀ LOSS OF DRILLING WATER
WATER TABLE-24HR.
WATER TABLE-1HR.

Westinghouse

Well Number: MW-1 Drilling Method: HOLLOW STEM AUGERS

Date Started: 10/11/89 Drilling Fluids: NONE

Date Finished: 10/11/89 Static Water Level: 31.81 Date: 12-6-89

Geologist/Engineer: T. TAYLOR Observed By: _____

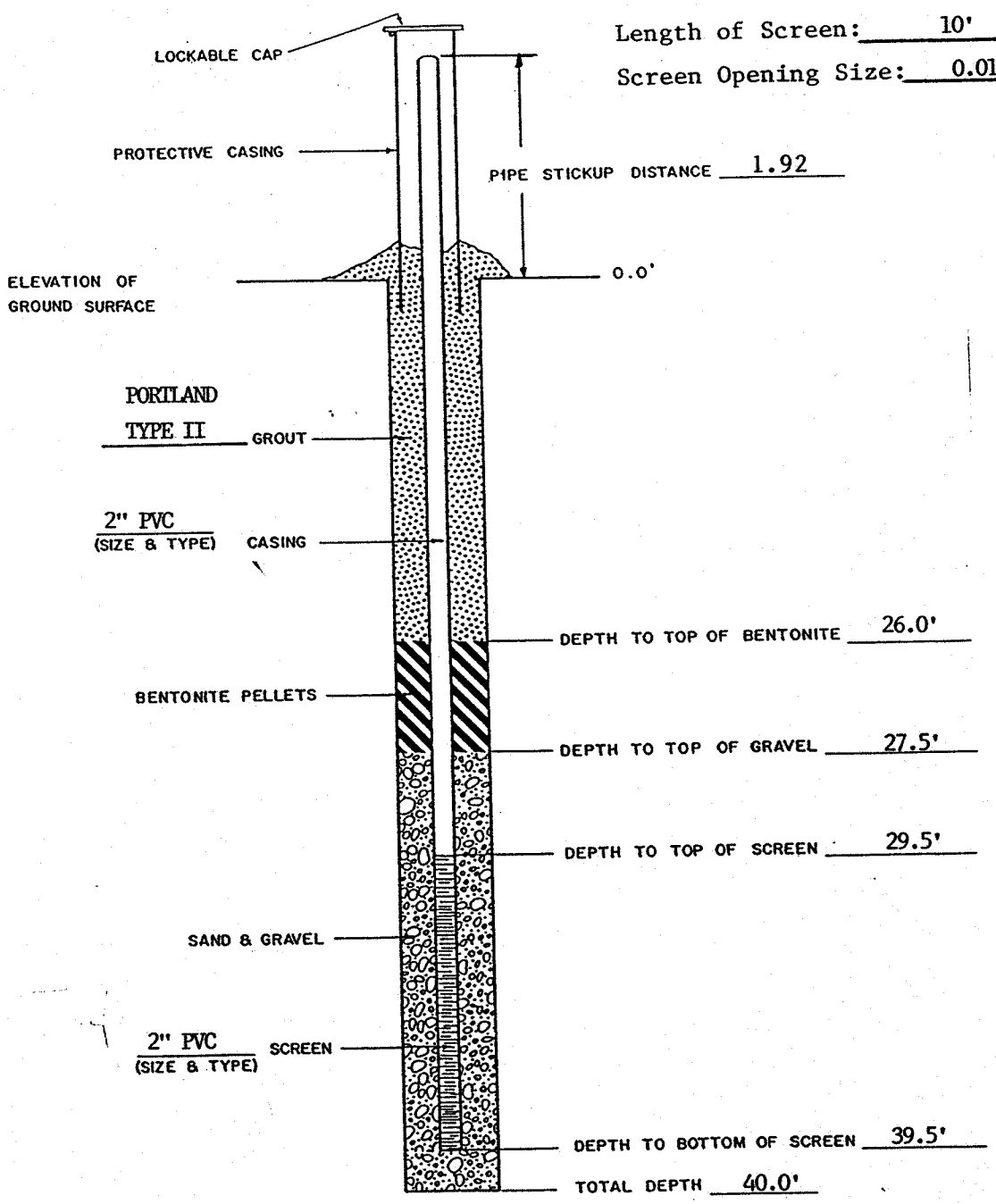
Remarks: _____

O.D. of Borehole: 8"

O.D. of Casing: 2.375"

Length of Screen: 10'

Screen Opening Size: 0.010"



PROJECT 31.81
WARREN CO. LANDFILL
WARRENTON, NC

Westinghouse

SCALE: NTS
JOB NO: 4112-89-123
FIG. NO:

Well Number: MW-2 Drilling Method: HOLLOW STEM AUGERS

Date Started: 10/11/89 Drilling Fluids: NONE

Date Finished: 10/11/89 Static Water Level: 5.88 Date: 12-6-89

Geologist/Engineer: T. TAYLOR Observed By: _____

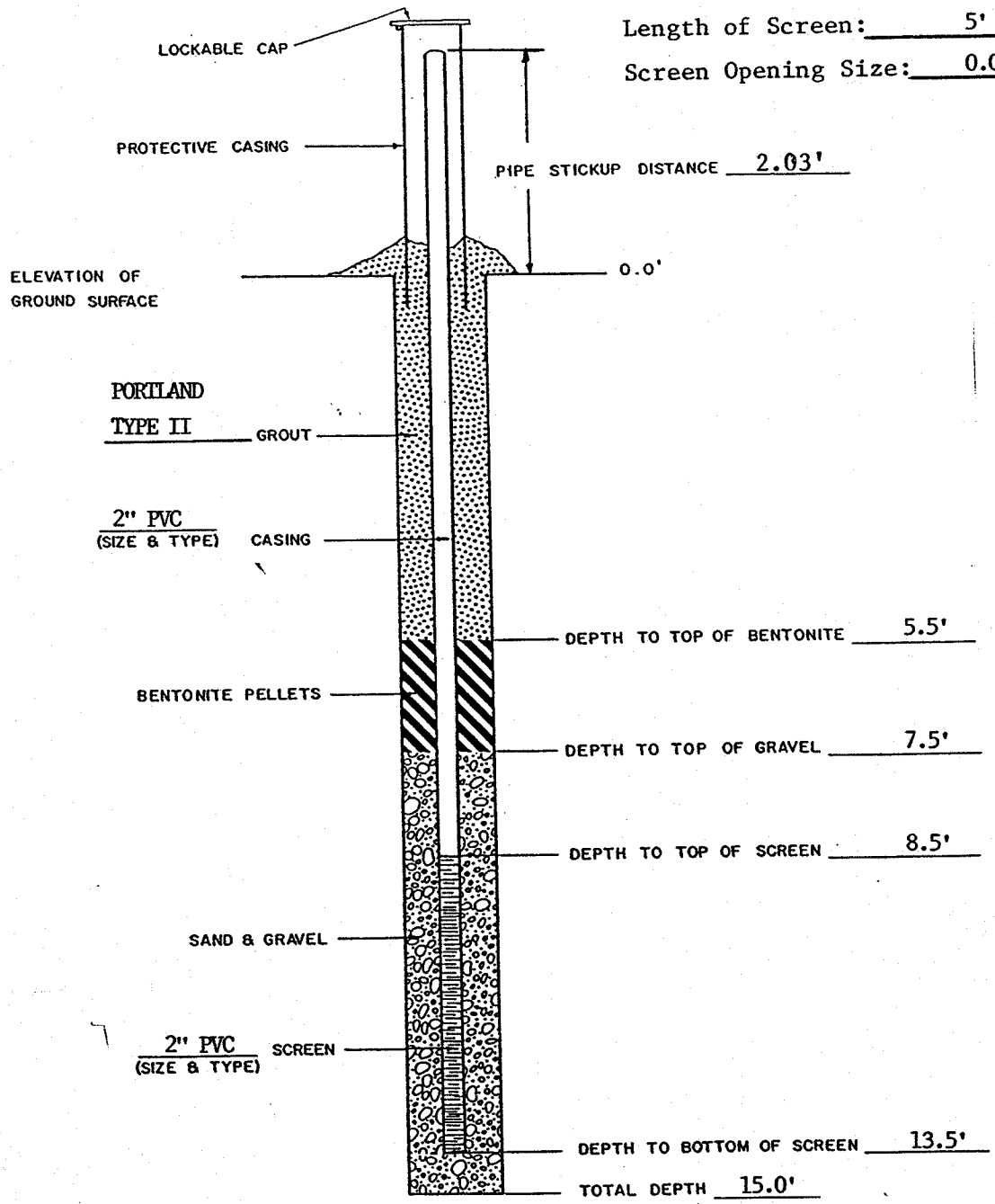
Remarks: _____

O.D. of Borehole: 8"

O.D. of Casing: 2.375"

Length of Screen: 5'

Screen Opening Size: 0.010"



PROJECT 5.88
WARREN CO. LANDFILL
WARRENTON, NC

Westinghouse

SCALE: NTS
JOB NO: 4112-89-123
FIG. NO:

Well Number: MW-3 Drilling Method: HOLLOW STEM AUGERS

Date Started: 10/10/89 Drilling Fluids: NONE

Date Finished: 10/10/89 Static Water Level: 5.22 Date: 12-6-89

Geologist/Engineer: T. TAYLOR Observed By:

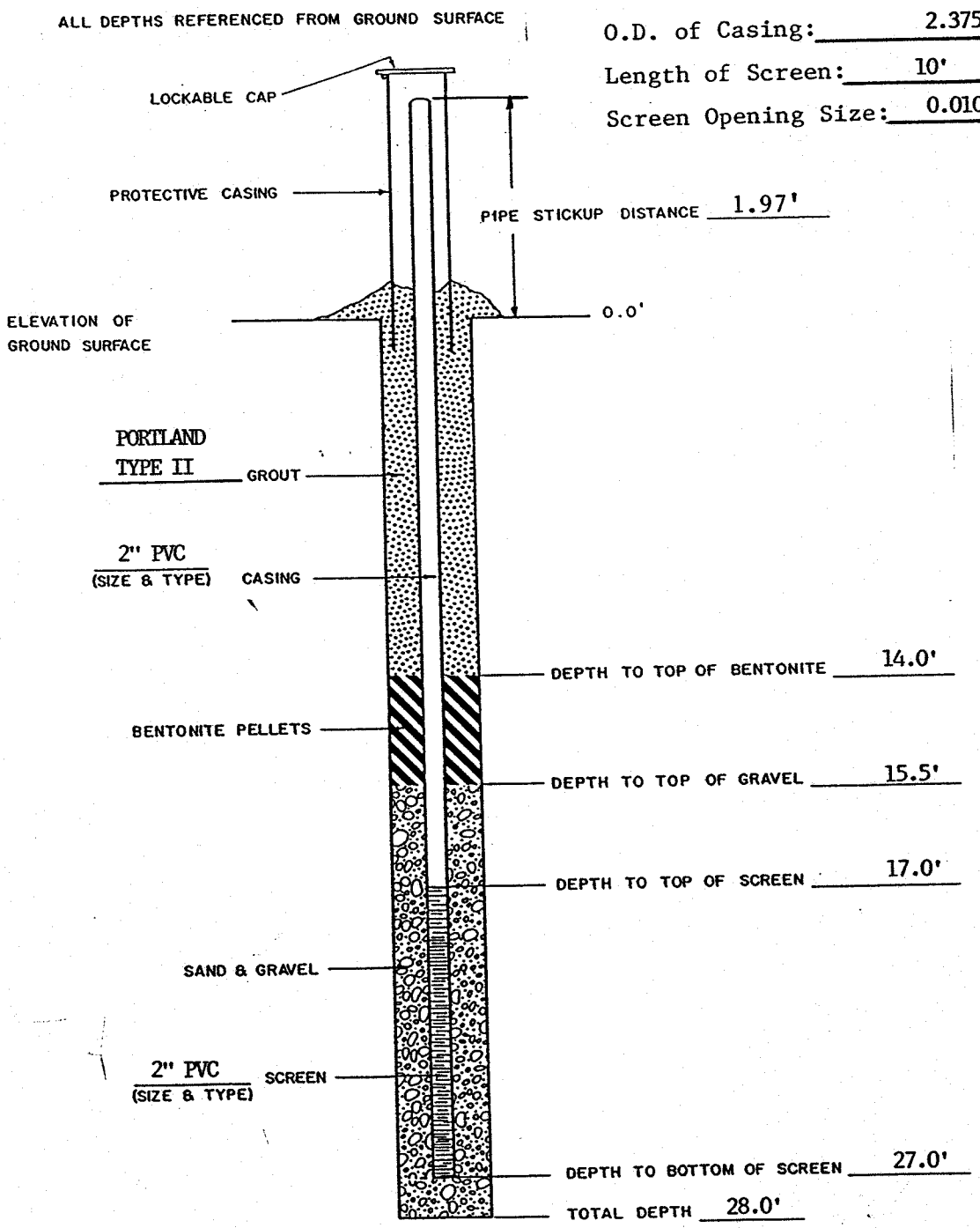
Remarks:

O.D. of Borehole: 8"

O.D. of Casing: 2.375"

Length of Screen: 10'

Screen Opening Size: 0.010"



PROJECT 5,22

WARREN CO. LANDFILL
WARRENTON, NC

Westinghouse

SCALE: NTS

JOB NO: 4112-89-123

FIG. NO:

Well Number: MW-4 Drilling Method: HOLLOW STEM AUGERS

Date Started: 10/10/89 Drilling Fluids: none

Date Finished: 10/10/89 Static Water Level: 4.33 Date: 12-6-89

Geologist/Engineer: T. TAYLOR Observed By: _____

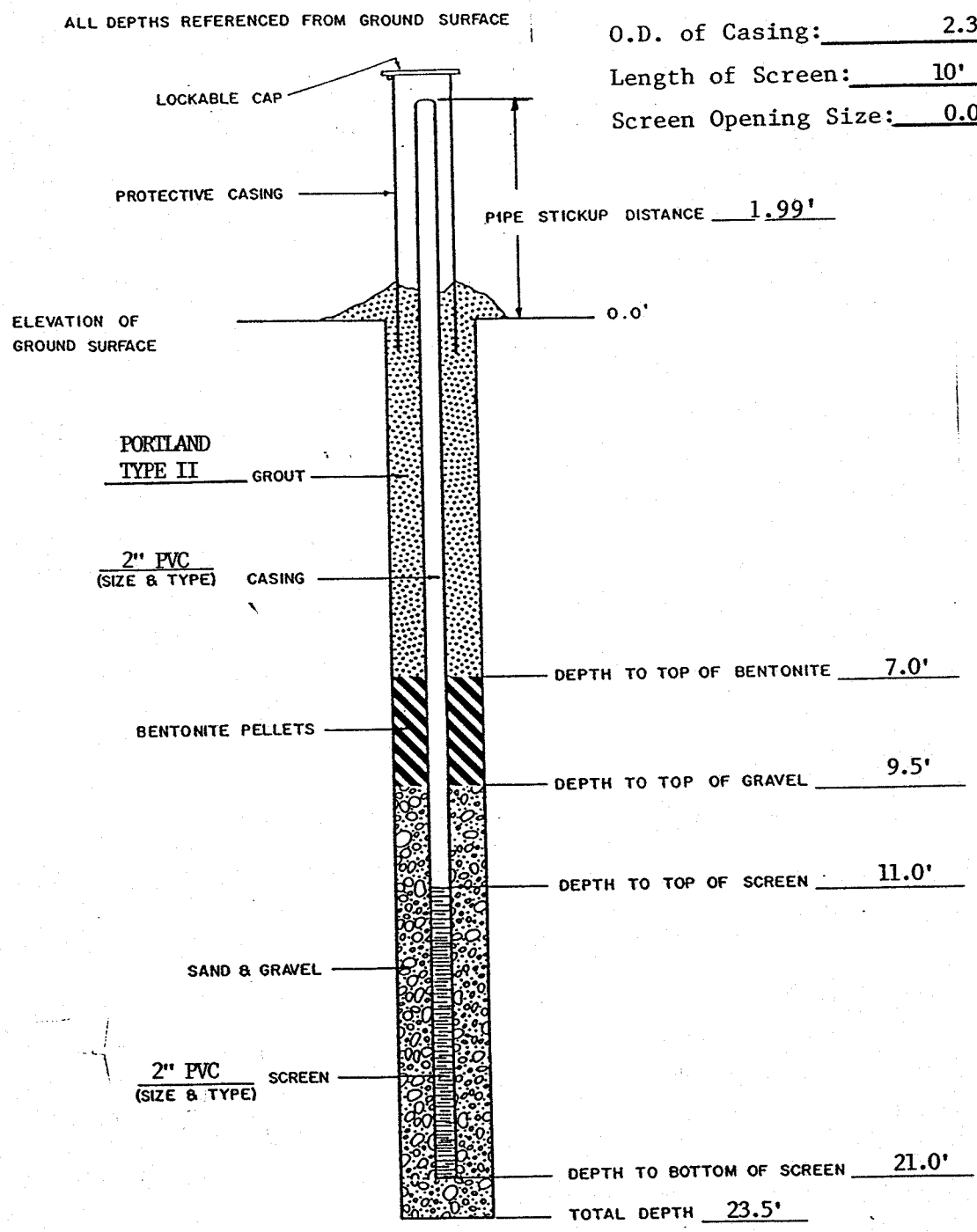
Remarks: _____

O.D. of Borehole: 8"

O.D. of Casing: 2.375"

Length of Screen: 10'

Screen Opening Size: 0.010"



PROJECT 4,33
WARREN CO. LANDFILL
WARRENTON, NC

Westinghouse

SCALE: NTS
JOB NO: 4112-89-123
FIG. NO:

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH,N.C. 27611, PHONE (919) 733-5083

FOR OFFICE USE ONLY
Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc ____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD GW-1

DRILLING CONTRACTOR: WESTINGHOUSE
DRILLER REGISTRATION NUMBER: 412
STATE WELL CONSTRUCTION PERMIT NUMBER: 92-0051-WM-0013

WELL LOCATION: (Show sketch of the location below)
Nearest Town: WARRENTON
(Road, Community, or Subdivision and Lot No.)
County: WARREN

OWNER: WARREN COUNTY
ADDRESS: 540 WEST RIDGEWAY (Street or Route No.)
WARRENTON (City or Town) NC (State) 27589 (Zip Code)

DATE DRILLED: 10/11/89 USE OF WELL: MONITOR
TOTAL DEPTH: 40.0 CUTTINGS COLLECTED: [X] Yes [ ] No
DOES WELL REPLACE EXISTING WELL? [ ] Yes [X] No
STATIC WATER LEVEL: 31.81 FT. [ ] above [X] below TOP OF CASING,
TOP OF CASING IS 1.92 FT. ABOVE LAND SURFACE.
YIELD (gpm): _____ METHOD OF TEST _____
WATER ZONES (depth): _____
CHLORINATION: Type _____ Amount _____

CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	29.5	_____ Ft.	2"	0.188	PVC
	_____	_____ Ft.	_____	_____	_____
	_____	_____ Ft.	_____	_____	_____

GROUT:

	Depth From	To	Material	Method
	26.0	0.0 Ft.	PORTLAND CEMENT	TREMIE
	27.5	26.0 Ft.	"HOLE PLUG" BENTONITE	POUR

2. SCREEN:

	Depth From	To	Diameter	Slot Size	Material
	39.5	29.5 Ft.	2" in.	0.010 in.	PVC
	_____	_____ Ft.	_____ in.	_____ in.	_____
	_____	_____ Ft.	_____ in.	_____ in.	_____

3. GRAVEL PACK:

	Depth From	To	Size	Material
	39.5	27.5 Ft.	FINE	QUARTZ SAND
	_____	_____ Ft.	_____	_____

4. REMARKS: _____

DRILLING LOG

Depth From	To	Formation Description
0.0	7.0	Reddish - Brown And Gray Fine Sandy Clayey Silt- FILL
7.0	16.0	Reddish - Tan Micaceous SILT (ML)
16.0	22.0	Tan And White Silty Fine to Medium SAND (SM)
22.0	40.0	Tan SILT (ML)- Saprolite

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Thomas U. Lee 10-23-89
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH,N.C. 27611, PHONE (919) 733-5083

FOR OFFICE USE ONLY
Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD MW-2

DRILLING CONTRACTOR: WESTINGHOUSE
DRILLER REGISTRATION NUMBER: 412
STATE WELL CONSTRUCTION PERMIT NUMBER: 92-0051-WM-0013

WELL LOCATION: (Show sketch of the location below)
Nearest Town: WARRENTON
(Road, Community, or Subdivision and Lot No.)
OWNER: WARREN COUNTY
ADDRESS: 540 WEST RIDGEWAY (Street or Route No.)
WARRENTON (City or Town) NC (State) 27589 (Zip Code)
DATE DRILLED: 10/11/89 USE OF WELL: MONITOR
TOTAL DEPTH: 15.0 CUTTINGS COLLECTED: [X] Yes [ ] No
DOES WELL REPLACE EXISTING WELL? [ ] Yes [X] No
STATIC WATER LEVEL 5.80 ~~35.80~~ FT. [ ] above [X] below TOP OF CASING,
TOP OF CASING IS 2.03 FT. ABOVE LAND SURFACE.
YIELD (gpm): _____ METHOD OF TEST _____
WATER ZONES (depth): _____
CHLORINATION: Type _____ Amount _____

County: WARREN

DRILLING LOG

Depth From	Depth To	Formation Description
0.0	6.5	Tan Micaceous SILT (ML)
6.5	13.0	Tan Micaceous Silty Fine To Medium SAND (SM)
13.0	15.0	Brown Micaceous SILT (ML) w/ Sand, Gravel And Rock Fragements

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

CASING:

	Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	8.5			2"	0.188"	PVC

GROUT:

	Depth From	To	Ft.	Material	Method
	5.5	0.0		PORTLAND CEMENT	POUR
	7.5	5.5		"HOLE PLUG" BENTONITE	POUR

SCREEN:

	Depth From	To	Ft.	Diameter	Slot Size	Material
	13.5	8.5		2" in.	0.010 in.	PVC
				in.	in.	
				in.	in.	

GRAVEL PACK:

	Depth From	To	Ft.	Size	Material
	13.5	7.5		FINE	QUARTZ SAND

REMARKS: _____

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Thomas C. Olson — 10-23-89
SIGNATURE OF CONTRACTOR OR AGENT — DATE

Submit original to Division of Environmental Management and copy to well owner.

RT CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT – GROUNDWATER SECTION
P.O. BOX 27687 – RALEIGH,N.C. 27611, PHONE (919) 733-5083

FOR OFFICE USE ONLY
Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD GW-3

ILLING CONTRACTOR: WESTINGHOUSE
ILER REGISTRATION NUMBER: 412
STATE WELL CONSTRUCTION PERMIT NUMBER: 92-0051-WM-0013

'ELL LOCATION: (Show sketch of the location below)
e st Town: WARRENTON
Road, Community, or Subdivision and Lot No.)
WNER: WARREN COUNTY
DDRESS: 540 WEST RIDGEWAY (Street or Route No.)
WARRENTON (City or Town) NC (State) 27589 (Zip Code)
DATE DRILLED: 10/10/89 USE OF WELL: MONITOR
TAL DEPTH: 28.0 CUTTINGS COLLECTED: [X] Yes [ ] No
DOES WELL REPLACE EXISTING WELL? [ ] Yes [X] No
STATIC WATER LEVEL: 5.22 FT. [ ] above [X] below TOP OF CASING,
TOP OF CASING IS 1.97 FT. ABOVE LAND SURFACE.
YIELD (gpm): _____ METHOD OF TEST _____
WATER ZONES (depth): _____
CHLORINATION: Type _____ Amount _____

County: WARREN

Depth From	Depth To	DRILLING LOG Formation Description
0.0	16.0	Light Gray To Brown Fine Sandy Micaceous SILT (ML) Trace Quartz Fragments
16.0	27.0	Light Gray Micaceous Silty Fine SAND (SM)
27.0	28.0	Partially Weathered MICA SHIST

If additional space is needed use back of form.

CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	17.0	_____ Ft.	2"	0.188	PVC
	_____	_____ Ft.	_____	_____	_____
	_____	_____ Ft.	_____	_____	_____

GROUT:

	Depth From	To		Material	Method
	14.0	0.0	Ft.	PORTLAND CEMENT	POUR
	15.5	14.0	Ft.	"HOLE PLUG" BENTONITE	POUR

SCREEN:

	Depth From	To	Diameter	Slot Size	Material
	27.0	17.0 Ft.	2" in.	0.010 in.	PVC
	_____	_____ Ft.	_____ in.	_____ in.	_____
	_____	_____ Ft.	_____ in.	_____ in.	_____

GRAVEL PACK:

	Depth From	To	Size	Material
	27.0	15.5 Ft.	FINE	QUARTZ SAND
	_____	_____ Ft.	_____	_____

REMARKS: _____

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Thomas L. Tyson — 10-23-89
SIGNATURE OF CONTRACTOR OR AGENT — DATE

Submit original to Division of Environmental Management and copy to well owner.

CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT – GROUNDWATER SECTION
P.O. BOX 27687 – RALEIGH,N.C. 27611, PHONE (919) 733-5083

FOR OFFICE USE ONLY
Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD MW-4

DRILLING CONTRACTOR: WESTINGHOUSE
DRILLER REGISTRATION NUMBER: 412
STATE WELL CONSTRUCTION PERMIT NUMBER: 92-0051-WM-0013

WELL LOCATION: (Show sketch of the location below)
Nearest Town: WARRENTON
County: WARREN
(Road, Community, or Subdivision and Lot No.)

OWNER: WARREN COUNTY
ADDRESS: 540 WEST RIDGEWAY (Street or Route No.)
WARRENTON (City or Town) NC (State) 27589 (Zip Code)

DATE DRILLED: 10/10/89 USE OF WELL: MONITOR
TOTAL DEPTH: 23.5 CUTTINGS COLLECTED: [X] Yes [ ] No
DOES WELL REPLACE EXISTING WELL? [ ] Yes [X] No
STATIC WATER LEVEL: 4.33 FT. [ ] above [X] below TOP OF CASING,
TOP OF CASING IS 1.99 FT. ABOVE LAND SURFACE.
YIELD (gpm): _____ METHOD OF TEST _____
WATER ZONES (depth): _____
CHLORINATION: Type _____ Amount _____

CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	11.0	_____ Ft.	2"	0.188	PVC
	_____	_____ Ft.	_____	_____	_____
	_____	_____ Ft.	_____	_____	_____

GROUT:

	Depth From	To	Material	Method
	7.0	0.0 Ft.	PORTLAND CEMENT	POUR
	9.5	7.0 Ft.	"HOLE PLUG" BENTONITE	POUR

SCREEN:

	Depth From	To	Diameter	Slot Size	Material
	21.0	11.0 Ft.	2" in.	0.010 in.	PVC
	_____	_____ Ft.	_____ in.	_____ in.	_____
	_____	_____ Ft.	_____ in.	_____ in.	_____

GRAVEL PACK:

	Depth From	To	Size	Material
	23.5	9.5 Ft.	FINE	QUARTZ SAND
	_____	_____ Ft.	_____	_____

REMARKS: _____

DRILLING LOG

Depth From	To	Formation Description
0.0	8.0	Gray to Red Fine Sandy Micaceous SILT (ML)
8.0	14.5	Greenish - Gray Micaceous SILT (ML)
14.5	20.0	Tan To Gray Fine Sandy Micaceous SILT (ML) With Rock Fragments
20.0	23.5	Gray Fine Sandy Micaceous SILT (ML) - SAPROLITE

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CONTRACTOR OR AGENT — DATE 10/23/89

Submit original to Division of Environmental Management and copy to well owner.

N. C. Department of Human Resources
Division of Health Services

WELL COMPLETION RECORD

PLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C.
TMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH,
X 2091, RALEIGH, N.C. 27602

MW-1

F SITE: WARREN COUNTY LANDFILL	PERMIT NO.: 93-01
S: 540 WEST RIDGEWAY , WARRENTON, NC 27589	OWNER (print): WARREN COUNTY
G CONTRACTOR: WESTINGHOUSE DRILLING	REGISTRATION NO.: 412

g Type: PVC dia. 2 in.
g epth: from 29.5 to 1.92 ft. - dia. ____ in.
n Type: PVC dia. 2 in.
n Depth: from 39.5 to 29.5 ft. - dia. ____ in.

Grout Depth: from 26.0 to 0.0 ft. - dia. 8 in.
Bentonite Seal: from 27.5 to 26.0 ft. - dia. 8 in.
Sand/Gravel PK: from 39.5 to 27.5 ft. - dia. 8 in.
Total Well Depth: from 39.5 to 0.0 ft. - dia. 8 in.

ater Level: 31.81 feet from top of casing Date Measured ___ / ___ / ___

(gpm): ____ Method of Testing: ____ Casing is ____ feet above land surface

DRILLING LOG

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
0	7.0	Reddish - Brown And Gray Fine Sandy Clayey Silt - FILL
.0	16.0	Reddish - tan Micaceous SILT (ML)
.0	22.0	Tan And White Silty Fine to Medium SAND (SM)
.0	40.0	Tan SILT (ML)- Saprolite

LOCATION SKETCH

(show distance to numbered roads, or other map reference points)

RKS: ____

TE: 10/17/89 SIGNATURE: Thomas C. Tofo

S 42 (6/85)
id & Hazardous Waste Management Branch

N. C. Department of Human Resources
Division of Health Services

WELL COMPLETION RECORD

PLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C.
TMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH,
X 2091, RALEIGH, N.C. 27602

MW-2

F SITE: WARREN COUNTY LANDFILL	PERMIT NO.: 93-01
S: 540 WEST RIDGEWAY , WARRENTON, NC 27589	OWNER (print): WARREN COUNTY
LING CONTRACTOR: WESTINGHOUSE DRILLING	REGISTRATION NO.: 412

Type:	PVC	dia.	2	in.	Grout Depth:	from 5.5	to 0.0	ft. - dia.	8 in.
epth:	from 8.5	to +2.03	ft. - dia.	in.	Bentonite Seal:	from 7.5	to 5.5	ft. - dia.	8 in.
Type:	PVC	dia.	2	in.	Sand/Gravel PK:	from 13.5	to 7.5	ft. - dia.	8 in.
Depth:	from 13.5	to 8.5	ft. - dia.	in.	Total Well Depth:	from 13.5	to ____	ft. - dia.	8 in.

ter Level: 5.80 feet from top of casing Date Measured ____ /____ /____

(gpm): ____ Method of Testing: ____ Casing is ____ feet above land surface

DRILLING LOG

DEPTH FROM	DEPTH TO	FORMATION DESCRIPTION
.0	6.5	Tan Micaceous SILT (ML)
.5	13.0	Tan Micaceous Silty Fine To Medium SAND (SM)
.0	15.0	Brown Micaceous SILT (ML) With Sand, Gravel And Rock Fragments

LOCATION SKETCH

(show distance to numbered roads, or other map reference points)

RKS: ____

TE: 10/17/89 SIGNATURE: Thomas W. Taylor

3 2 (6/85)
& Hazardous Waste Management Branch

N. C. Department of Human Resources
Division of Health Services

WELL COMPLETION RECORD

IPLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C. ARTMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH, OX 2091, RALEIGH, N.C. 27602

MW-3

OF SITE: WARREN COUNTY LANDFILL	PERMIT NO.: 93-01
SS: 540 WEST RIDGEWAY , WARRENTON, NC 27589	OWNER (print): WARREN COUNTY
LING CONTRACTOR: WESTINGHOUSE DRILLING	REGISTRATION NO.: 412

g Type: PVC dia. 2 in. Grout Depth: from 14.0 to 0.0 ft. - dia. 8 in.
g Depth: from 17.0 to 1.97 ft. - dia. ____ in. Bentonite Seal: from 15.5 to 14.0 ft. - dia. 8 in.
n Type: PVC dia. 2 in. Sand/Gravel PK: from 27.0 to 15.5 ft. - dia. 8 in.
n Depth: from 27.0 to 17.0 ft. - dia. ____ in. Total Well Depth: from 27.0 to ____ ft. - dia. 8 in.

ater Level: 5.22 feet from top of casing Date Measured ____ / ____ / ____

(gpm): ____ Method of Testing: ____ Casing is ____ feet above land surface

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTION
0	16.0	Light Gray To Brown Fine Sandy Micaceous SILT (ML) Trace Quartz Fragments
16.0	27.0	Light Gray Micaceous Silty Fine SAND (SM)
27.0	28.0	Partially Weathered MICA SCHIST

LOCATION SKETCH

(show distance to numbered roads, or other map reference points)

RKS: ____

TE: 10/17/89 SIGNATURE: Thomas W. Igoe

S 42 (6/85)
d & Hazardous Waste Management Branch

N. C. Department of Human Resources
Division of Health Services

WELL COMPLETION RECORD

(PLETE ALL INFORMATION REQUESTED BELOW FOR EACH WELL INSTALLED, AND RETURN FORM TO THE N.C. A TMENT OF HUMAN RESOURCES, SOLID AND HAZARDOUS WASTE MANAGEMENT BRANCH, B X 2091, RALEIGH, N.C. 27602

MW-4

F SITE: WARREN COUNTY LANDFILL	PERMIT NO.: 93-01
S: 540 WEST RIDGEWAY , WARRENTON, NC 27589	OWNER (print): WARREN COUNTY
LING CONTRACTOR: WESTINGHOUSE DRILLING	REGISTRATION NO.: 412

g Type: PVC dia. 2 in.
g epth: from 17.0 to 1.99 ft. - dia. ____ in.
n Type: PVC dia. 2 in.
n Depth: from 27.0 to 17.0 ft. - dia. ____ in.

Grout Depth: from 14.0 to 0.0 ft. - dia. 8 in.
Bentonite Seal: from 15.5 to 14.0 ft. - dia. 8 in.
Sand/Gravel PK: from 27.0 to 15.5 ft. - dia. 8 in.
Total Well Depth: from 27.0 to ____ ft. - dia. 8 in.

: ater Level: 4.33 feet from top of casing Date Measured ____ /____ /____

. (gpm): ____ Method of Testing: ____ Casing is ____ feet above land surface

DRILLING LOG

DEPTH (COM	TO	FORMATION DESCRIPTION
.0	8.0	Gray To Red Fine Sandy Micaceous SILT (ML)
.0	14.5	Greenish - Gray Micaceous SILT (ML)
.5	20.0	Tan To Gray Fine Sandy Micaceous SILT (ML) With Rock Fragments
0.0	23.5	Gray Fine Sandy Micaceous SILT (ML)- SAPROLITE

LOCATION SKETCH

(show distance to numbered roads, or other map reference points)

MARKS: ____

ATE: 10/17/89 SIGNATURE: Thomas V. Taylor

Industrial & Environmental Analysts, Inc.
P.O. Box 12846
Research Triangle Park, North Carolina 27709
(919) 467-9919
FAX (919) 460-0948

December 29, 1989

Brian Hayes
Westinghouse Env. & Geotechnical Services, Inc.
P.O. Box 1308
Cary, NC 27512

Reference IEA Report No.: 115342
Project I.D.: 4112-89-123

Dear Mr. Hayes,

Transmitted herewith are the results of analyses on four samples submitted to our laboratory on December 7, 1989.

Please see the enclosed reports for your results.

Very truly yours,

INDUSTRIAL & ENVIRONMENTAL ANALYSTS, INC.

Linda F. Mitchell
Manager, Technical Support Group

State Certification:

Alabama - #40210	New Jersey - #67719	South Carolina - #99021
Georgia - #816	Tennessee - #00296	North Carolina - #37720
Kansas - #E-158	Virgina - #00179	#84

IEA LABORATORY RESULTS

IEA Project #: 115-342
Client Name: Westinghouse Env. & Geotech. Services, Inc.

ample #	Client ID	Parameter	Results		Date Analyzed
1	MW-1	Biochemical Oxygen Demand	6.8	mg/L	12/07/89
2	MW-2	Biochemical Oxygen Demand	<2.0	mg/L	12/07/89
3	MW-3	Biochemical Oxygen Demand	<2.0	mg/L	12/07/89
4	MW-4	Biochemical Oxygen Demand	<2.0	mg/L	12/07/89
1	MW-1	Chloride	11	mg/L	12/11/89
2	MW-2	Chloride	8.4	mg/L	12/11/89
3	MW-3	Chloride	3.3	mg/L	12/11/89
4	MW-4	Chloride	3.5	mg/L	12/11/89
1	MW-1	Chemical Oxygen Demand	<25	mg/L	12/12/89
2	MW-2	Chemical Oxygen Demand	<25	mg/L	12/12/89
3	MW-3	Chemical Oxygen Demand	<25	mg/L	12/12/89
4	MW-4	Chemical Oxygen Demand	<25	mg/L	12/12/89
1	MW-1	Copper	<0.03	mg/L	12/18/89
2	MW-2	Copper	<0.03	mg/L	12/18/89
3	MW-3	Copper	0.06	mg/L	12/18/89
4	MW-4	Copper	0.04	mg/L	12/18/89
1	MW-1	Iron	0.49	mg/L	12/18/89
2	MW-2	Iron	7.4	mg/L	12/18/89
3	MW-3	Iron	3.0	mg/L	12/18/89
4	MW-4	Iron	2.6	mg/L	12/18/89
1	MW-1	Fluoride	<0.1	mg/L	12/14/89
2	MW-2	Fluoride	<0.1	mg/L	12/14/89
3	MW-3	Fluoride	<0.1	mg/L	12/14/89
4	MW-4	Fluoride	<0.1	mg/L	12/14/89
1	MW-1	Manganese	0.65	mg/L	12/18/89
2	MW-2	Manganese	1.1	mg/L	12/18/89
3	MW-3	Manganese	0.47	mg/L	12/18/89
4	MW-4	Manganese	0.35	mg/L	12/18/89
1	MW-1	Nitrate	0.41	mg/L	12/11/89
2	MW-2	Nitrate	<0.10	mg/L	12/11/89
3	MW-3	Nitrate	<0.10	mg/L	12/11/89
4	MW-4	Nitrate	<0.10	mg/L	12/11/89
1	MW-1	pH	5.2		12/11/89
2	MW-2	pH	5.7		12/11/89
3	MW-3	pH	6.2		12/11/89
4	MW-4	pH	6.5		12/11/89
1	MW-1	Arsenic	<0.005	mg/L	12/18/89
2	MW-2	Arsenic	<0.005	mg/L	12/18/89
3	MW-3	Arsenic	<0.005	mg/L	12/18/89
4	MW-4	Arsenic	<0.005	mg/L	12/18/89
1	MW-1	Barium	0.23	mg/L	12/18/89
2	MW-2	Barium	0.46	mg/L	12/18/89
3	MW-3	Barium	0.22	mg/L	12/18/89
4	MW-4	Barium	0.08	mg/L	12/18/89
1	MW-1	Cadmium	<0.01	mg/L	12/18/89

IEA LABORATORY RESULTS

IEA Project #: 115-342
Client Name: Westinghouse Env. & Geotech. Services, Inc.

Sample #	Client ID	Parameter	Results		Date Analyzed
2	MW-2	Cadmium	<0.01	mg/L	12/18/89
3	MW-3	Cadmium	<0.01	mg/L	12/18/89
4	MW-4	Cadmium	<0.01	mg/L	12/18/89
1	MW-1	Chromium	<0.03	mg/L	12/18/89
2	MW-2	Chromium	<0.03	mg/L	12/18/89
3	MW-3	Chromium	<0.03	mg/L	12/18/89
4	MW-4	Chromium	<0.03	mg/L	12/18/89
1	MW-1	Mercury	<0.0005	mg/L	12/18/89
2	MW-2	Mercury	<0.0005	mg/L	12/18/89
3	MW-3	Mercury	<0.0005	mg/L	12/18/89
4	MW-4	Mercury	<0.0005	mg/L	12/18/89
1	MW-1	Lead	0.006	mg/L	12/18/89
2	MW-2	Lead	0.007	mg/L	12/18/89
3	MW-3	Lead	<0.005	mg/L	12/18/89
4	MW-4	Lead	0.008	mg/L	12/18/89
1	MW-1	Selenium	<0.005	mg/L	12/18/89
2	MW-2	Selenium	<0.005	mg/L	12/18/89
3	MW-3	Selenium	<0.005	mg/L	12/18/89
4	MW-4	Selenium	<0.005	mg/L	12/18/89
1	MW-1	Silver	<0.03	mg/L	12/18/89
2	MW-2	Silver	<0.03	mg/L	12/18/89
3	MW-3	Silver	<0.03	mg/L	12/18/89
4	MW-4	Silver	<0.03	mg/L	12/18/89
1	MW-1	Sulfate	2.2	mg/L	12/13/89
2	MW-2	Sulfate	<2.0	mg/L	12/13/89
3	MW-3	Sulfate	<2.0	mg/L	12/13/89
4	MW-4	Sulfate	<2.0	mg/L	12/13/89
1	MW-1	Total Dissolved Solids	40	mg/L	12/12/89
2	MW-2	Total Dissolved Solids	30	mg/L	12/12/89
3	MW-3	Total Dissolved Solids	100	mg/L	12/12/89
4	MW-4	Total Dissolved Solids	20	mg/L	12/12/89
1	MW-1	Total Organic Carbon	35	mg/L	12/18/89
2	MW-2	Total Organic Carbon	26	mg/L	12/18/89
3	MW-3	Total Organic Carbon	19	mg/L	12/18/89
4	MW-4	Total Organic Carbon	23	mg/L	12/18/89
1	MW-1	Total Organic Halide	3.0	mg/L	12/11/89
2	MW-2	Total Organic Halide	2.6	mg/L	12/11/89
3	MW-3	Total Organic Halide	1.9	mg/L	12/11/89
4	MW-4	Total Organic Halide	2.8	mg/L	12/11/89
1	MW-1	Zinc	0.07	mg/L	12/18/89
2	MW-2	Zinc	0.06	mg/L	12/18/89
3	MW-3	Zinc	0.06	mg/L	12/18/89
4	MW-4	Zinc	0.04	mg/L	12/18/89

INDUSTRIAL & ENVIRONMENTAL ANALYSTS, INC.
1901 NORTH HARRISON AVE.
CARY, N.C. 27513

CHAIN OF CUSTODY RECORD

NO. 4581

PROJECT #	PROJECT NAME
4112-89-123	Warren Co. Landfill

SAMPLERS: (SIGNATURE)

B. L. Hayer

SAMPLE I.D.	DATE	TIME	COMP	GRAB	STATION LOCATION	# OF CONTAINERS	MATRIX SOIL	MATRIX WATER	REQUESTED PARAMETERS: Acetone to Ethyl Meth. Ket.	TOC	Tox	TDS	BOD	COD	Chloride, Fluoride	Nitrate	Sulfate	pH
MW-1	6-12-89	1600		✓		10		✓	1	2	1	1	1	1	1	1	1	✓
MW-2		1530		✓		10		✓	1	2	1	1	1	1	1	1	1	✓
MW-3		1320		✓		10		✓	1	2	1	1	1	1	1	1	1	✓
MW-4	↓	1345		✓		10		✓	1	2	1	1	1	1	1	1	1	✓

RELINQUISHED BY (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME
RELINQUISHED BY (SIGNATURE)	DATE	TIME	RECEIVED FOR LAB BY	DATE	TIME
Brian L. Hayer	7-12-89	0748	Joanna Foster	12/7/89	9:50

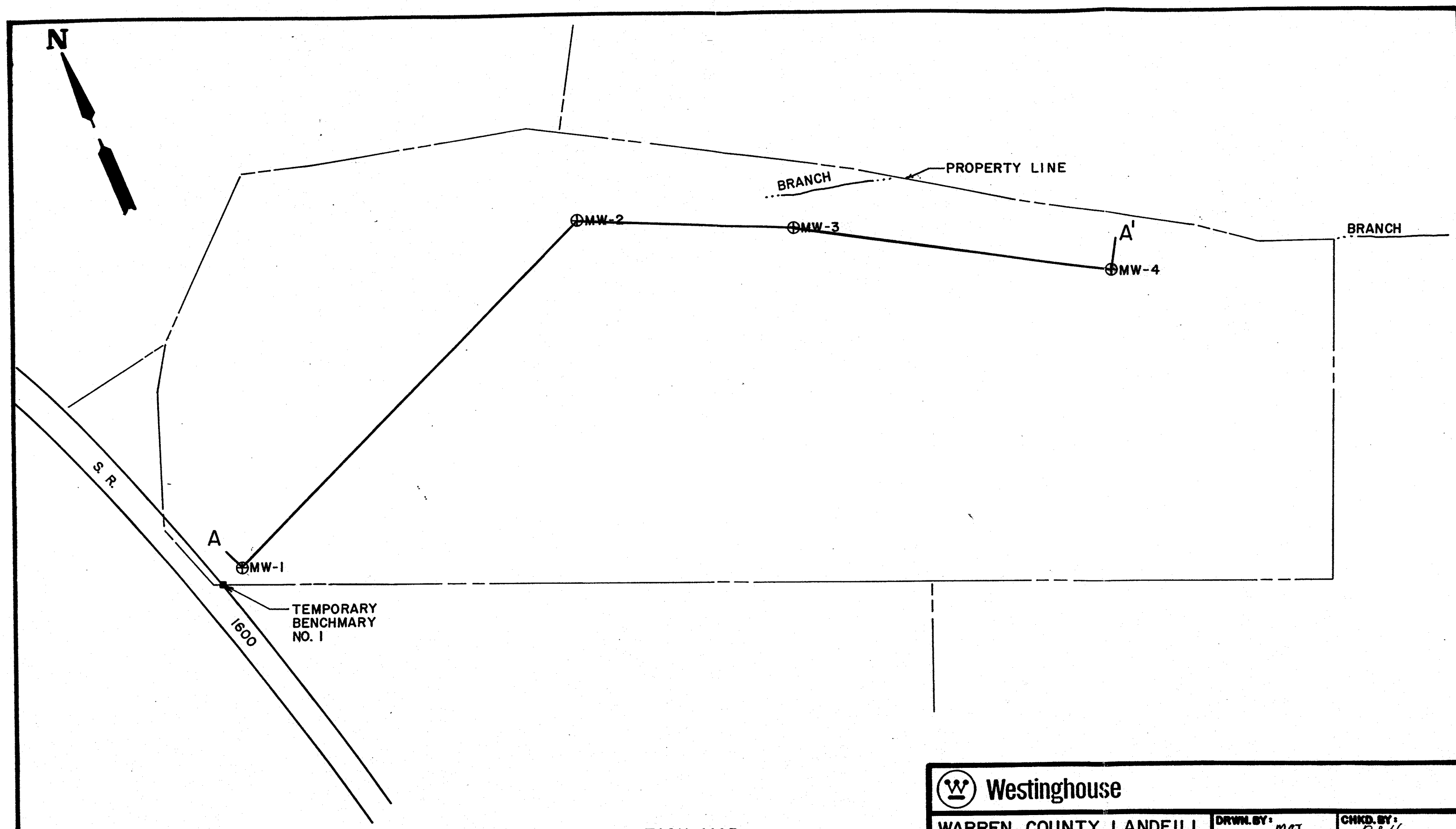
IEA REMARKS

IEA # 115.342

IEA QUOTE NO.	IEA RUSH NO.
PROJECT MANAGER (PLEASE PRINT)	P.O. NO.
Ann.	04541

FIELD REMARKS

Do pH on TDS Sample

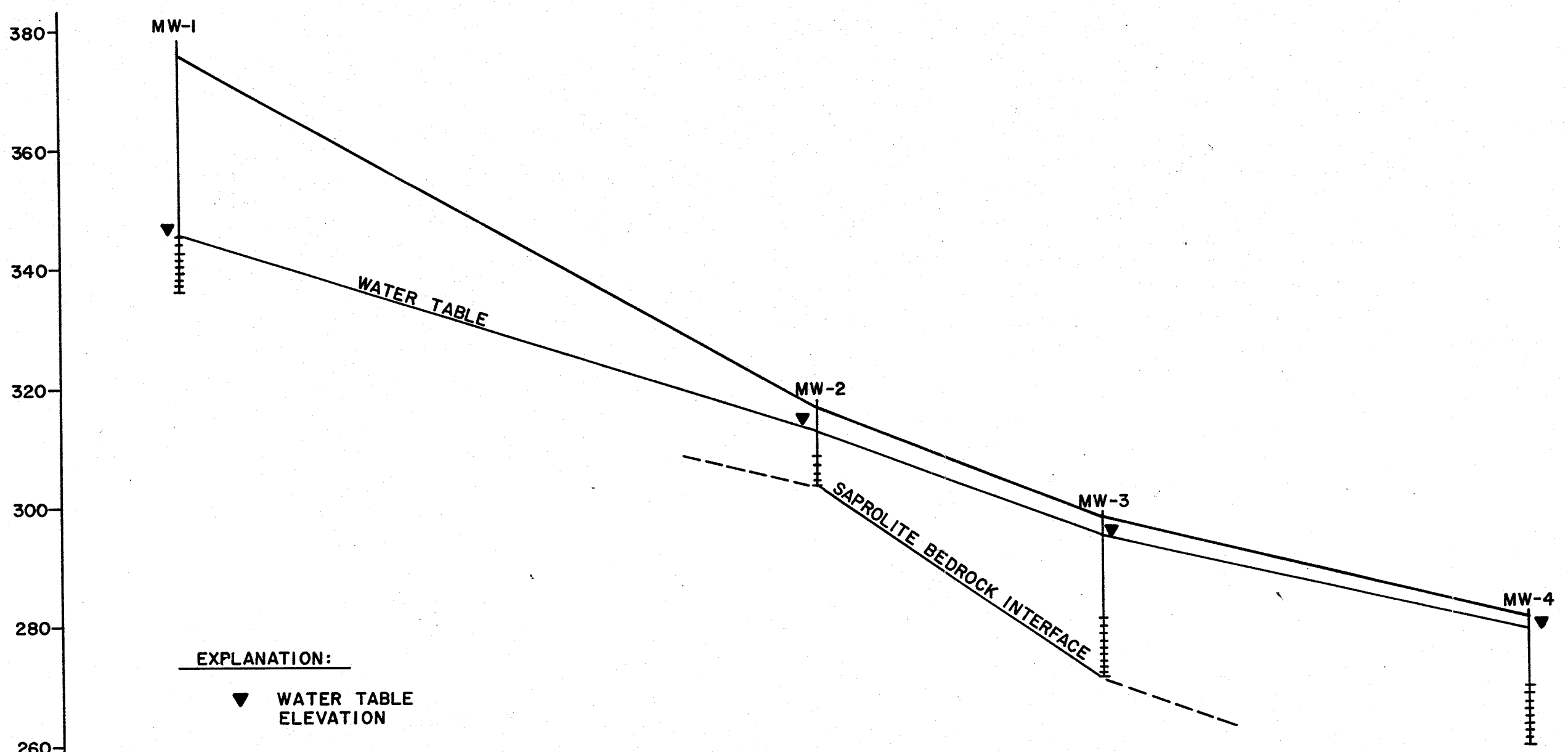


CROSS SECTION LOCATION MAP

Westinghouse

WARREN COUNTY LANDFILL WARRENTON, N. C. 93-01	DRWN. BY: mcj	CHKD. BY: BJH
	JOB NO.: 4112-89-123	DATE: 1/90
	SCALE: 1" = 200'	FIGURE: 1

DUNCAN-PARNELL, INC., RALEIGH 988 919-833-4677



EXPLANATION:

▼ WATER TABLE ELEVATION

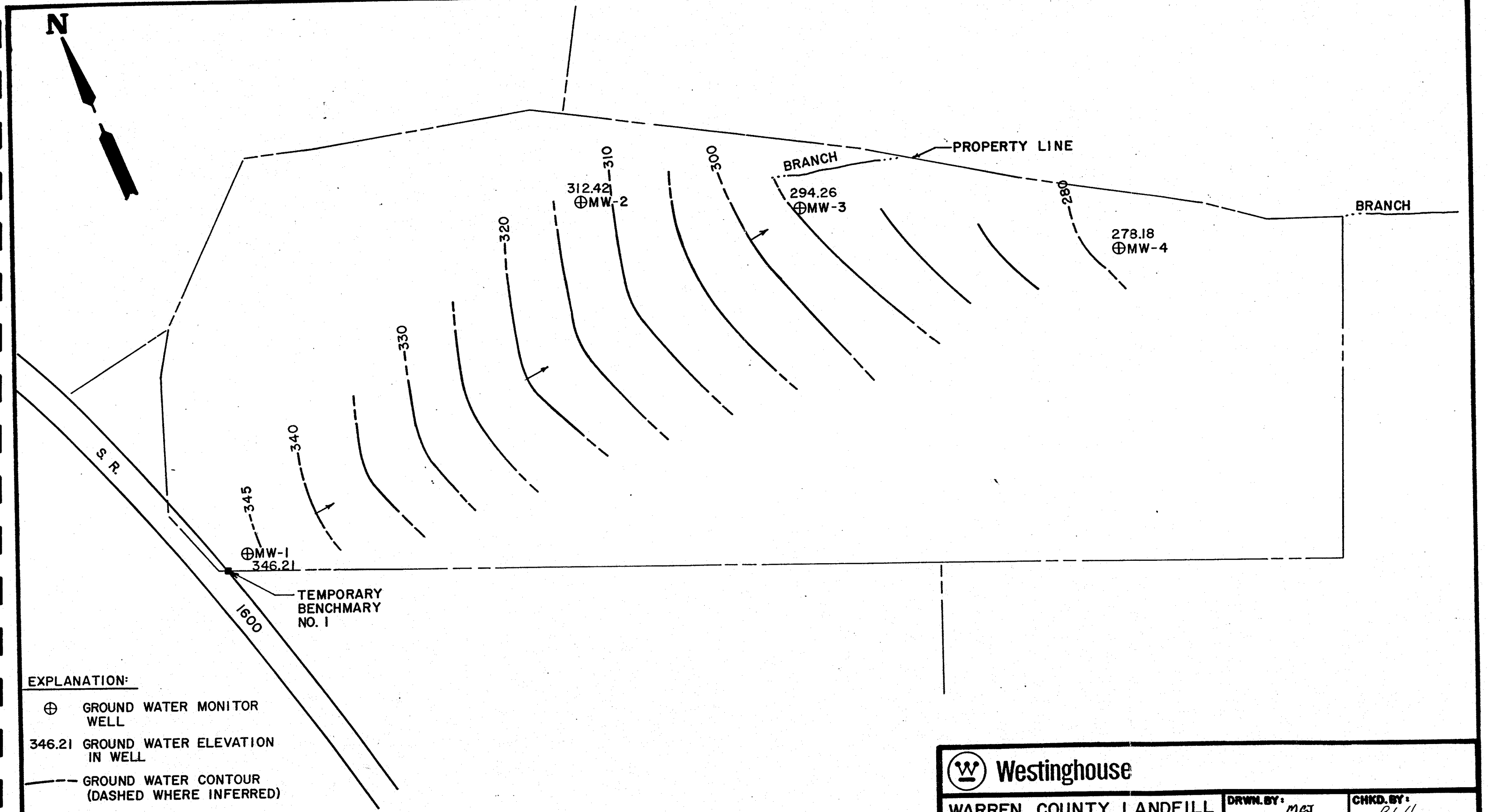
SCALE:

HORIZONTAL 1" = 200'

VERTICAL 1" = 20'

Westinghouse

WARREN COUNTY LANDFILL WARRENTON, N. C.	DRWN. BY: MCJ	CHKD. BY: BLH
	JOB NO.: 4112-89-123	DATE: 1/90
	SCALE: AS SHOWN	FIGURE: 2



EXPLANATION:

- ⊕ GROUND WATER MONITOR WELL
- 346.21 GROUND WATER ELEVATION IN WELL
- ---- GROUND WATER CONTOUR (DASHED WHERE INFERRED)
- → GROUND WATER FLOW DIRECTION

GROUND WATER CONTOUR MAP FOR 12/6/89

Westinghouse

WARREN COUNTY LANDFILL WARRENTON, N. C. 93-01	DRWN. BY: mcj	CHKD. BY: BLH
	JOB NO.: 4112-89-123	DATE: 1/90
	SCALE: 1" = 200'	FIGURE: 3